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Forest
Service

**Northern
Region**

Forest Insect and Disease Conditions 1978
in the Northern Region

compiled by
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Cover Photos

(front)

This photo shows a heavy concentration of dead trees which is part of the most spectacular mountain pine beetle infestation in the Northern Region. This infestation is occurring on State, private, and Federal lands on the Flathead National Forest and adjacent Glacier National Park.

(back)

The result of five years of mountain pine beetle epidemic in Gallatin Canyon, Gallatin National Forest...1978.

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Forest Service
Forest Insect and
Disease Management
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Introduction

The USDA, Forest Service in Region 1 has a staff of professional forest entomologists and pathologists responsible for the detection and evaluation of insects and diseases that threaten forest resources. These activities cover all forested lands in the Region regardless of ownership. Cooperative forest insect and disease programs between the Forest Service and the States of Idaho and Montana exist to allow for increased effort on State and private forest lands.

Detection of outbreaks is done in a number of ways including: 1) systematic aerial surveys to locate and map outbreaks; 2) remote sensing; 3) ground examination; and 4) working with foresters and other wood workers to encourage reporting of suspected insect and disease outbreaks.

Following detection, new or potential outbreaks are evaluated to determine their significance, probable cause, and the damage that can be expected with or without suppression.

From the detection and evaluation information collected, forest managers have a basis for planning management actions best suited for dealing with each situation.

This report is a summary of the status of the primary insect and disease problems that have been detected in Region 1 during 1978.

Conditions in Brief

*Major mountain pine beetle infestations occur on five National Forests and two National Parks in the Region. More than 42 MM lodgepole pine on 780 M acres and 298 M ponderosa pine on 65 M acres were killed. Fir engraver beetles killed subalpine fir on more than 7 M acres on nine National Forests in Montana and Idaho. Douglas-fir beetle and spruce beetle caused only minor damage. Western spruce budworm defoliation decreased by 1.2 MM acres, but destroyed cones of Douglas-fir, grand fir, and western larch. Defoliation of western larch by larch casebearer was masked by the occurrence of a needle disease. The forest tent caterpillar defoliated 150 M acres of aspen in North Dakota. Spring and fall cankerworms defoliated Siberian elm shelter-belts in North Dakota. Douglas-fir tussock moth populations remained low. Other insects causing minor damage were the pine butterfly, a needle miner, and the gouty pitch midge in ponderosa pine; and two sawflies in western larch.

More than 150 M ponderosa pine and lodgepole pine seedlings were discarded at Coeur d'Alene due to an unidentified needle pathogen. Seedling root disease losses at Coeur d'Alene were as great as 25 percent in seedbeds and 10 percent in greenhouses. Gray mold killed nearly all container-grown western larch seedlings in one greenhouse. Several needle diseases and needle rusts occurred throughout the Region, and with the exception of *Meria laricis* on western larch, caused only minor defoliation. Aspen leaf rust occurred throughout Montana and Idaho. Stem cankers, rusts, and decays remained static. *Armillaria* root disease centers occur frequently in the eastern part of the Region, and new combinations of pathogens are occurring in western Montana. *Ribes* eradication for white pine blister rust control was found to be no more effective in Yellowstone National Park than elsewhere.

Sulfur dioxide caused damage to conifers near Helena and Anaconda, Montana, and Kellogg, Idaho. Based on 10 years of study by Forest Insect and Disease Management, the U.S. Department of Justice filed suit against the Anaconda Aluminum Company at Columbia Falls, Montana. The suit claims flouride from the plant has damaged timber, wildlife, and esthetic values.

Dwarf mistletoe-infested residual trees were removed from 5,700 acres on four National Forests and presuppression surveys were made on more than 11 M acres on three National Forests. A dwarf mistletoe impact assessment was made on more than 25 M acres. Dutch elm disease was found in Billings, Montana, for the first time, but the evidence suggests it has been there for 6 to 10 years.

*Listing of insect and disease common/scientific names are in appendix.

Entomology
Bark Beetles

Mountain Pine Beetle

Mountain pine beetle infestations continued at an accelerating rate in much of the Region in 1978 (table 1). Major infestations occur on the Beaverhead, Gallatin, Flathead, Lolo, and Kootenai National Forests and in Glacier and Yellowstone National Parks (figure 1). A review of the status of the major outbreak areas follows:

Beaverhead National Forest

The number of acres of red-topped lodgepole pine increased from about 20,000 in 1977 to nearly 80,000 on the Beaverhead NF in 1978. Significant tree mortality was visible from Reynolds Pass, at the south end of the Madison Ranger District in tributaries along both sides of the Madison River, north to the Tobacco Root Mountains. Approximately 16,400 acres of white bark pine stands are infested along higher elevations of the Madison River between Quake Lake and Jack Creek. The epidemic infestation which began in 1972 in the Jack Creek drainage, declined in ntensity from 1977 to 1978 due to depletion of the large diameter lodgepole pine (figure 2). A continued decline in this area is predicted in 1979. Beetle populations are expected to increase throughout much of the Forests in 1979 with new infestations developing in many mature lodgepole pine stands on the Madison Ranger District.

Gallatin National Forest

The massive infestation in the Bozeman-Gallatin and Hebgen Ranger Districts increased from about 273,000 acres in 1977 to nearly 297,000 acres in 1978. The epidemic continued to envelop susceptible stands in tributaries of the Spanish Creek drainage, Gallatin Canyon, and continued to spread into susceptible stands northeast toward Bozeman Pass on the Bozeman-Gallatin Ranger District. Tree killing intensified at West Yellowstone Flats, and new infestations occurred west at Targhee Pass, around Hebgen Lake, and north to Little Teepee Creek on the Hebgen Ranger District. About 15.5 million lodgepole pine were killed in 1978 on the Forest. Epidemic conditions are expected to persist with many new stands being infested in 1979. Tree killing will continue to decline in Hellroaring and Logger Creek drainages and in the lower Gallatin Canyon where infestation began in 1969.

In 1977 over 3,000 trees were killed by the mountain pine beetle in, or adjacent to 10 campgrounds and administrative sites on the Hebgen Ranger District. To prevent additional loss of these high value trees, 10,877 of the highest hazard trees (those over 7" dbh) were sprayed with Sevimol 4® prior to beetle attack in 1978 (figure 3). Over 99.8 percent of the sprayed trees remained free from beetles even though extensive mortality continued throughout the general area. Plans have been made to retreat these high use areas in 1979.

Yellowstone National Park

This infestation expanded from about 129,000 in 1977 to over 171,000 acres in 1978. In excess of 8.9 million trees were killed in 1978. Epidemic infestation occurs around Old Faithful Inn and in Upper Geyser Basin, west to the Wyoming-Idaho-Montana border, and north to Divide Lake. We predict the infestation will continue to spread north, enveloping susceptible mature stands in the Park and some stands on the Gallatin NF in 1979.

Figure 3.–Sevimol 4 being applied to prevent mountain pine beetle attack in a public campground. Gallatin National Forest, 1978.

Figure 2.–Gray trees represent those killed by MPB during previous years.

Table 1 *Mountain pine beetle infestations in Region 1 in 1978.*

		Acres			Trees		
		LPP	**PP**	**WBP**	**LPP**	**PP**	**WBP**
Beaverhead	FS	44,207		4,783	437,649		15,550
	NFS	17,865		520	176,863		850
Bitterroot	FS	499	1,098		499	1,098	
	NFS		1,794			1,794	
Deerlodge	FS	32			32		
	NFS			6,118			6,118
Flathead	FS	48,519	25	150	3,883,001	25	432
	NFS	30,042	1,266		2,373,318	1,266	
Gallatin	FS	192,589			8,473,916		
	NFS	52,110			1,459,080		
Helena	FS	737	75	453			1,375
	NFS		125				
Kootenai	FS	23,269	30		988,649		100
	NFS	3,266	100		69,239		
Lewis & Clark	FS		4,088			4,088	
	NFS		30,156			30,156	
Idaho Panhandle	FS		550			550	200
	NFS						
Lolo	FS	7,425	1,427	50	170,775	82,757	145
	NFS	3,634	3,292		83,582	177,109	155
Nezperce	FS	800			4,000		
	NFS						
Glacier NP		164,017			14,761,530		
Yellowstone NP		171,244			10,274,640		
Totals	FS	318,077	7,293	5,436	13,408,521	88,518	17,602
	NFS	106,917	36,733	6,638	29,129,013	210,325	6,968
Grand Total		780,344	65,008	12,099	42,537,534	298,834	24,595

Abbreviations used:
LPP = Lodgepole pine
PP = Ponderosa pine
WBP = Whitebark pine
FS = Forest Service land
NFS = Non-Forest Service land

Flathead National Forest

The most extensive infestation in the Region is in the North Fork Flathead River drainage, Glacier View Ranger District and adjacent Glacier National Park. The infestation on the Forest increased from 44,364 acres to 108,558; a 2.4 fold increase from 1977 to 1978. Number of infested trees increased from 55 to 79 per acre from 1977 to 1978. More than 8.5 million trees containing 500 MMBF were killed between the Big Creek drainage and the Canadian border. Massive beetle flight continue to infest available susceptible stands in this area and many small diameter, younger trees are being killed.

New red-topped groups of trees were detected in the Middle Fork Flathead River drainage as far east as Essex. Also, newly infested groups were directed around mill yards at Columbia Falls and Olney. Other groups of current year faders were observed at Little Bitterroot, Ashley, Rodgers, and McGregor Lakes on the Whitefish Ranger District.

Infestations will continue to develop and spread into stands in the middle North and South Fork of the Flathead River drainages, and in stands on the Talley Lake and Swan Ranger Districts. Over 80 percent of the mature and overmature lodgepole will likely be killed in the next 8 years.

Incidental killings of mature and overmature ponderosa pine occurred on the west side of Lake Mary Ronan. Faded groups ranged from 25-300 trees per group and were scattered throughout the Dayton Creek drainage. One group of 100 trees was detected near Hubbart Lake, Tally Lake Ranger District.

Mountain pine beetle infestations in western white pine remain static, with groups of 5-30 trees per group scattered along both sides of the Hungry Horse Reservoir, Hungry Horse Ranger District; and between Spoon Lake and McGinnis Creek in the Canyon, Kimmerly, and Depuy drainages, Glacier View Ranger District.

Lolo National Forest

Increased beetle attacks occurred in lodgepole pine in the Bear Trap, Fish Trap, and Thompson River drainaes of the Plains Ranger District. Acres infested increased from near 10,500 in 1977 to almost 14,700 in 1978. Number of lodgepole pine killed increased from about 240,000 in 1977 to over 800,000 in 1978.

Extensive beetle caused mortality occurred in second-growth ponderosa pine stands on Federal, State, and private lands in the Blackfoot and Clark Fork River drainages north and east of Missoula. About 430,000 ponderosa pine were killed in 1978. Infestations are building up in the Nine Mile drainage and near St. Regis. Epidemics are expected to persist in all areas with a predicted increase in area infested and number of trees killed in 1979.

Glacier National Park

The Glacier National Park infestation has encompassed more area with more trees killed per acre than any other infestation experienced in the Region in the past 3 decades. Infestation developed to epidemic proportions in 1970, and by 1978 had spread over 164,292 acres. Extensive tree mortality extends from the Canadian Border at the north end of the Park south to Howe Ridge. More than 100 beetle killed trees per group occur around McDonald Lake and Park Headquarters near West Glacier. The infestation has extended from the North Fork Flathead River east to Upper Kintla Lake, to the east end of Bowman, Quartz, and Rodgers Lakes, and in many areas east throughout the lodgepole pine type. In 1978, an average of 87.9 trees were killed per acre, (range 1-296 killed per acre). This is a total of more than 14 million trees.

Beetle populations will continue at an epidemic level in 1979. A population decline is occurring between Logging Ridge and Quartz Ridge where the epidemic first developed. Populations will continue to invade stands toward Park Headquarters, and in the Middle and North Fork drainages of Federal, State, and private ownerships adjacent to the Park.

As many as 7 trees per acre of overmature ponderosa pine are being killed near Bowman Lake. Ponderosa pine mortality from mountain pine beetle is low elsewhere in the Park.

Kootenai National Forest

Aerial surveys detected an increase in number of red-topped trees in 1978 on the Kootenai NF. Over 230,000 trees were killed on 21,700 acres in 1977, increasing to more than 630,000 trees being killed on 29,800 acres in 1978. The single most intensive infestation occurs in the Yaak River drainage, Yaak Ranger District.

Scattered red-topped groups ranging from 5 to 1,000 trees per group were scattered throughout the Rexford, Fortine, Libby, and Fisher River Ranger Districts. All infested areas are expected to intensify in 1979.

Lewis and Clark National Forest

Infestations in second-growth ponderosa pine stands declined from 81,800 acres in 1977 to 64,400 acres in 1978 on Federal, State, and private lands, Lewis and Clark NF, Montana. The number of infested trees decreased from 573,000 in 1977 to 64,400 in 1978. Snowbreakage, windthrow, and overstocked stands are contributing factors to a buildup of beetle populations in these stands. We predict the infestations will remain static or continue to decline. However, windstorms, snowbreakage, etc., could provide conditions conducive for a population buildup which would reverse the predicted downward trend.

Bitterroot National Forest

Acres infested in mixed lodgepole-ponderosa pine stands decreased from 1977 to 1978 on the north face of Shook Mountain, Sula Ranger District. The number of red-topped trees plunged from 108,300 in 1977 to about 5,000 in 1978,

and infested acres decreased fourfold. A continued decline is predicted in 1979.

Tree killing in lodgepole pine stands continued for a second year on 800 acres around Dennis Mountain in the Salmon River Breaks, Bitterroot National Forest, Idaho. Tree killing is predicted to increase in 1979 because the lodgepole pine in these stands is mature and of large diameters.

Helena National Forest

Mortality of white bark pine declined in 1978 in the Swamp Creek drainage, Townsend Ranger District. The majority of large diameter trees have been killed and a continued decline in tree mortality is predicted for 1979.

Engraver Beetles

Pine engraver beetle *Ips pini* (Say) populations continued to decline on the Idaho Panhandle NF's, Idaho, and Lolo National Forest, Montana. Populations flared to epidemic level in logging slash and in wind broken trees, then infested trees occurring on draughty soils in 1976. Tree resistance recovered following above normal precipitation during 1977-78, which resulted in a decline in Ips populations.

Two engraver beetles, *Pityophthorus pseudotsugae* and *Cryphalus ruficollios,* caused extensive mortality to subalpine fir on 27,680 acres on nine National Forests in Idaho and Montana in 1977, then infested acres declined to 7,348 acres in 1978. Most severe tree killing occurs on the Sandpoint Ranger District, Idaho Panhandle NF's, Idaho, Hungry Horse Ranger District, Flathead NF, and Bozeman-Gallatin Ranger District, Gallatin NF, Montana.

Mortality to pole-size Douglas-fir increased from 2,003 acres in 1977 to 2,715 acres in 1978 in Idaho and Montana. Mortality appears to occur in moisture stressed stands.

Douglas-fir Beetle

Douglas-fir beetle populations have declined in the Selway River drainage, Selway Ranger District, Nezperce National Forest, and Eagle Creek drainage, Wallace Ranger District, Idaho Panhandle National Forest, Idaho since 1976. Major infestations have occurred in these areas since 1975 when beetle populations built up in windthrow and snow broken trees then moved to adjacent green stands in 1976. Evaluations indicate a continued population decline through 1979.

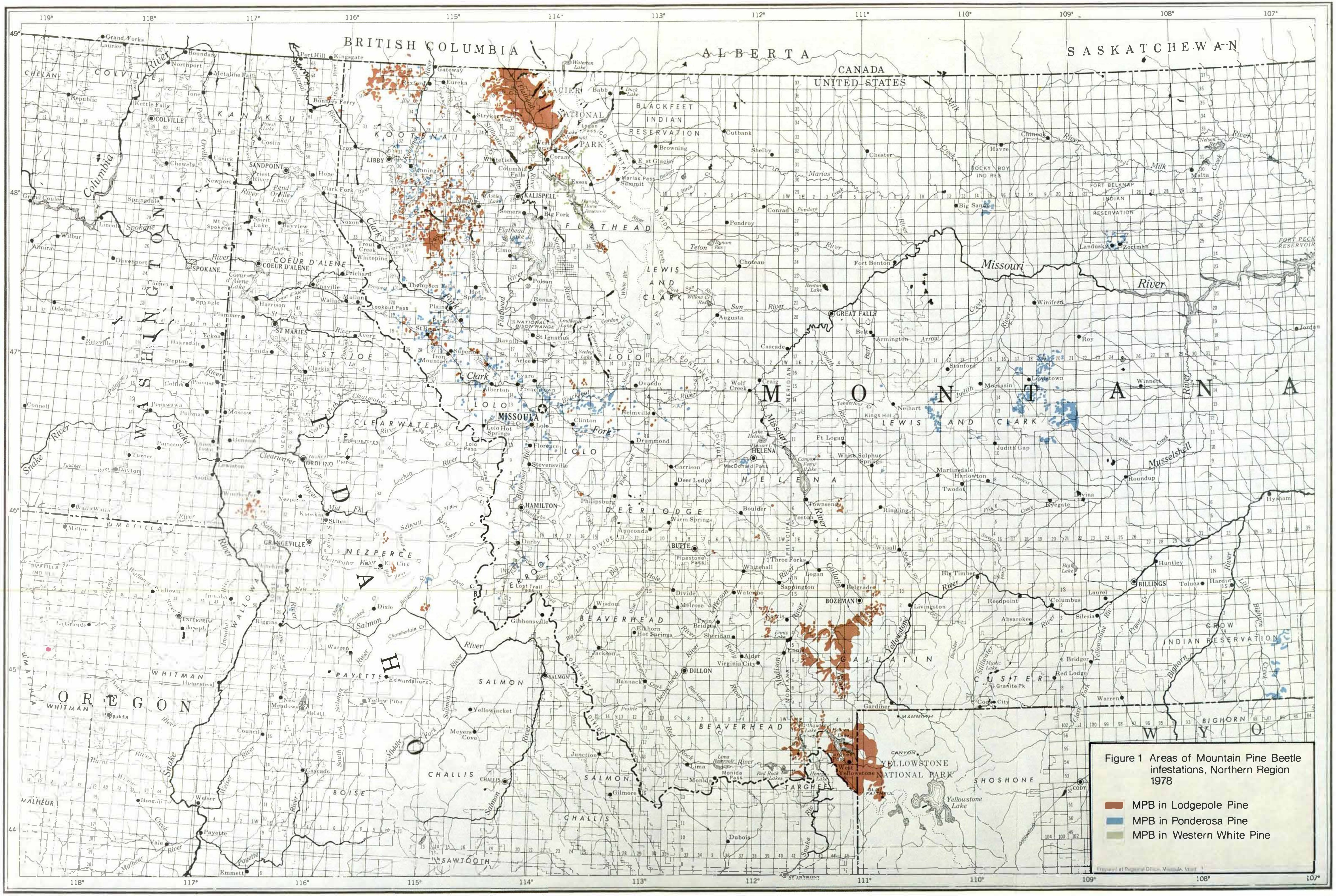

Figure 1 Areas of Mountain Pine Beetle infestations, Northern Region 1978

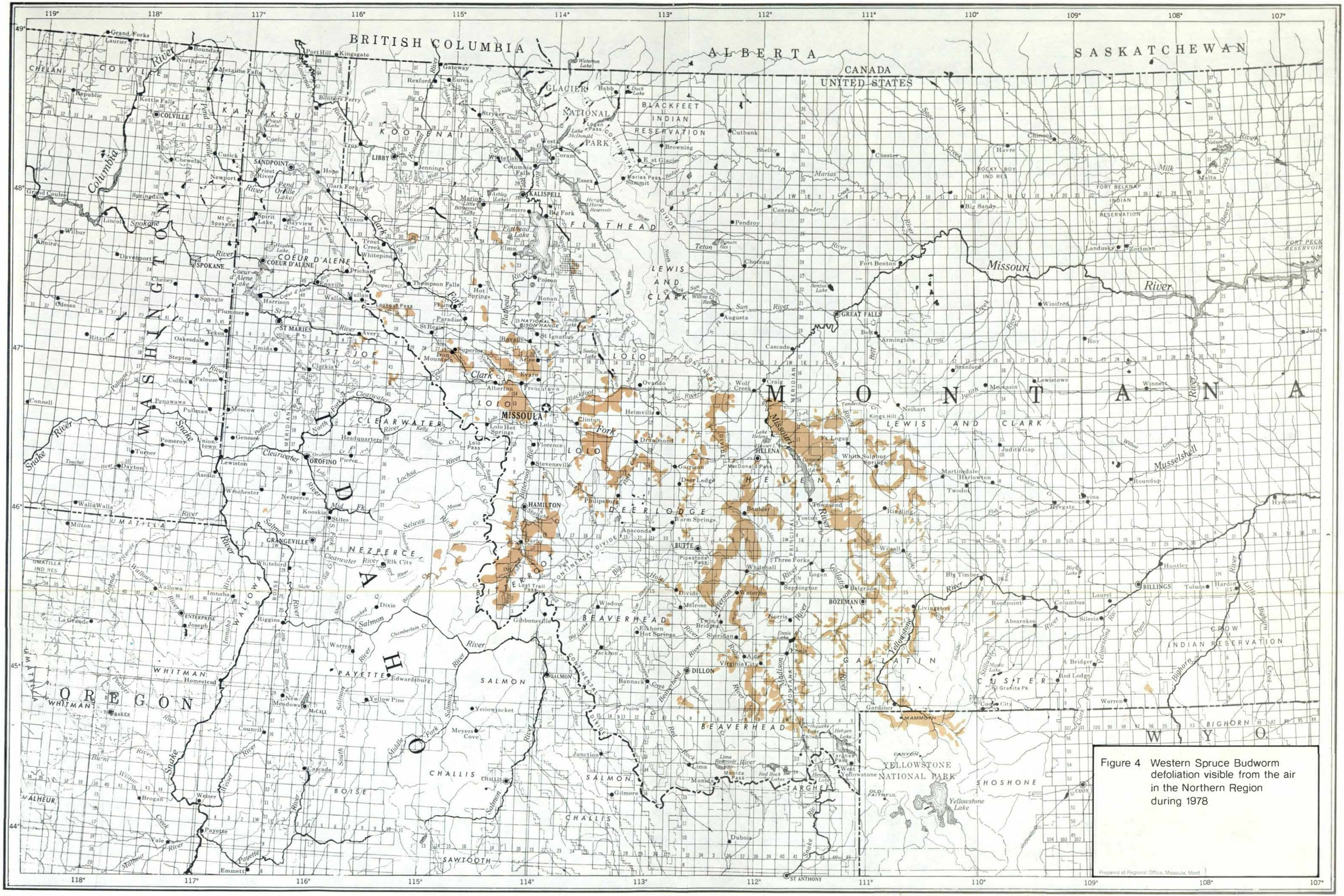

Figure 4 Western Spruce Budworm defoliation visible from the air in the Northern Region during 1978

Defoliators and Cone and Shoot Insects

Western Spruce Budworm

The western spruce budworm epidemic declined in many areas in the Region in 1978, but increased substantially on the Beaverhead, Deerlodge, Helena, and Lewis and Clark National Forests, and Yellowstone National Park (table 2). Total acres of defoliation visible from the air decreased from 3,701,231 in 1977 to 2,520,246 in 1978 (figure 4).

Extensive budworm egg-mass surveys, covering an area equivalent to a Ranger District or more, were conducted on the Helena, Gallatin, and Bitterroot National Forests. Average defoliation in these areas in 1979 is predicted to be moderate in all Units, except for the Yellowstone Unit of the Gallatin National Forest where heavy defoliation is predicted (table 3).

An intensive egg-mass survey, confined to a localized area, was conducted on a budworm-infested elk winter range on the Madison Ranger District of the Beaverhead National Forest. Heavy defoliation and some tree mortality is predicted for 1979. Another intensive survey near the Savenac Nursery on the Lolo National Forest revealed no budworm egg-masses, and little or no defoliation is expected in 1979.

There were no field tests, pilot control, or operational projects of chemical or microbial insecticides to control budworm in the Northern Region in 1978. However, field tests of microbial insecticides using ground spray equipment are planned to control budworms in infested campgrounds on the Gallatin National Forest in 1979.

Table 2

Acres of aerially visible[1] western spruce budworm defoliation in the Northern Region in 1977 and 1978.

Unit[2]	Acres of Visible Defoliation		Change in Size of Infestation
Northern Idaho	**1977**	**1978**	**Area**
	Acres		
Clearwater NF	286407	8,115	– 278,292
Idaho Pandandle NF	176,454	7,416	– 169,038
Nez Perce NF	184,315	4,590	– 179,725
Subtotal	647,176	20,121	– 627,055
Montana			
Beaverhead NF	173,250	223,720	+ 50,470
Bitterroot NF[3]	451,495	379,112	– 72,383
Custer NF	7,370	3,625	– 3,745
Deerlodge NF	183,207	382,762	+ 199,555
Flathead IR	129,438	50,566	+ 78,872
Flathead NF	54,527	15,171	– 39,356
Gallatin NF	427,990	293,265	– 134,725
Helena NF	462,979	75,151	+ 112,172
Kootenai NF	20,029	14,604	– 5,425
Lewis & Clark	116,499	176,294	+ 59,795
Lolo NF	947,941	281,161	– 666,780
Subtotal	2,974,725	2,395,431	– 597,294
Wyoming			
Yellowstone NP	79,330	104,694	+ 25,364
Grand Total	3,701,231	2,520,246	– 1,180,985

[1]Aerially visible defoliation occurs when 25 percent or more of current foliage is destroyed.

[2]Infested acreage includes Federal, State, and private land.

[3]A portion of this forest is in north Idaho. (34,605 acres in northern Idaho were defoliated in 1978).

Table 3

Mean numbers of western spruce budworm egg-masses per square meter of host foliage in 1978 and defoliation predicted for 1979.

National Forest	Unit	No. of Plots	New Egg-masses per Square Meter[1]	Predicted Defoliation	
				%[2]	category[3]
Bitterroot	East	9	23.0	46	moderate
	West	10	23.2	46	moderate
Helena	West	20	37.1	53	moderate
	South	16	46.6	58	moderate
	Canyon Ferry	9	30.8	50	moderate
	Townsend	10	30.9	50	moderate
Gallatin	Bridges	17	38.3	54	moderate
	Gal. Canyon	18	34.3	52	moderate
	Yellowstone	18	72.2	71	heavy
Beaverhead	Madison RD (Wall Creek)	10	97.1	82	heavy
Lolo	Savenac Nursery	4	0.0	0	none

[1] Foliar area determined by (branch length × branch width[2].

[2] Predicted percent defoliation, Y, is computed as Y = 34.687 + 0.504 X, where X equals egg-masses per square meter.

[3]Light defoliation = 0 to 37.5 percent of new needles defoliated, moderate defoliation = > 37.5 percent to 62.5 percent defoliation, and heavy defoliation = > 62.5 percent defoliation.

Larch Casebearer

Defoliation caused by the larch casebearer was masked this year by a needle disease on western larch. Because of this an aerial survey to detect casebearer defoliation was not made. Feeding damage was quite noticeable for the first time in the forests around Seeley Lake, Montana.

Several selected plots near Columbia Falls, Montana, and Priest River, Idaho, were evaluated for the casebearer parasites, *Agathis pumila* (Ratzeburg) and *Chyrsocharis laricinellae* (Ratzeburg). Up to 60 per cent parasitism by *A. pumila*, and 30 percent by *C. larincinellae* were found. Parasite collections from these areas were made in April for release by cooperators in Oregon and Washington.

Cone and Seed Insects

Forty existing or planned seed production areas were examined as potential survey sites for insects affecting cone and seed production. Only 21 areas had sufficient cone crops to allow systematic cone collections. These areas were:

(list follows on next page)

Damage varied considerably among seed production areas and tree species. Greatest losses to cones of Douglas-fir, grand fir, and western larch were caused by western spruce budworm, midges, and cone worms (figure 5). Ponderosa pine cones were most severely damaged by cone worms. The mountain pine cone beetle was the primary pest of western white pine cones. It destroyed 67 percent of the high value, genetically superior cones produced at the Sandpoint seed orchard. Approximately 8,000 beetle infested cones have been sent to the Insecticide Evaluation Project at Berkely, California,to screen insecticides for potential control of this insect in seed orchards and seed production areas. Lodgepole pine cones were damaged less by insects than all other tree species.

Forest	Seed Production Area	Tree Species Surveyed
Bitterroot	Buck Creek	Lodgepole Pine
	Eight Mile	Douglas-fir
	South Ambrose	Western Larch
	Slocum-Claremont	Lodgepole Pine
	Wheeler Creek	Ponderosa Pine
Flathead	Wolf Creek	Douglas-fir & Ponderosa Pine
	Bond Creek	Douglas-fir
	Mount Creek	Western Larch
	Hungry Horse Dam	Western Larch
Helena	Lincoln Gulch	Lodgepole Pine
	Colorado Mountain	Lodgepole Pine
	Cooper's Lake	Western Larch
Idaho Panhandle	Kelly Mountain	Douglas-fir & Western White Pine
	Sand Point Seed Orchard	Western White Pine
Kootenai	Coyote Flat	Ponderosa Pine
	Bristow Creek	Douglas-fir
	Fisher Creek	Lodgepole Pine
	Rocky Creek	Ponderosa Pine
Lewis & Clark	Moose Creek	Lodgepole Pine
Lolo	Henry Creek	Douglas-fir, Ponderosa Pine, & Western Larch
Nezperce	Potato Hill	Grand fir

Figure 5.–Damage to Douglas-fir cones caused by western spruce budworm.

Figure 6.–Forest tent caterpillar populations are increasing in isolated locations in the Region.

Regeneration Pests

A total of 97 plantations planted within the past 5 years on the Lolo, Flathead, Clearwater, and Nezperce National Forests were surveyed intensively to determine causes of seedling mortality or injury. Plot data are being analyzed, but preliminary results indicate that planting procedures, damage by stock animals and wildlife, and spruce budworm, were major causes of seedling loss or damage.

Forest Tent Caterpillar

Populations of this caterpillar have been epidemic in neighboring Manitoba, Canada and Minnesota during the 1970's. By 1976, these outbreaks reached North Dakota's Turtle Mountains. Heavy defoliation occurred mainly to aspen scattered throughout about 150,000 acres in 1978 (figure 6).

Larval and pupal mortality from parasites and diseases was very heavy; however, during a biological evaluation in October, new egg-masses were found in tree crowns at 42 to 63 plots sampled. Defoliation in 1979 is predicted to be spotty and light throughout the aspen stand of the Turtle Mountains. Several spots of moderate defoliation are expected around Lake Metigoshe and east of Carpenter Lake.

Douglas-fir Tussock Moth

Tussock moth populations remain at very low levels in the Region. Pheromone baited sticky-traps calibrated to detect building populations, were deployed in 21 areas of previously known infestations (figure 7). Only one male moth was collected from the 12 sites that were surveyed in Idaho. Moths were trapped at six of the nine plots surveyed in Montana; however, total numbers captured were too low to expect outbreak levels next year.

Spring and Fall Cankerworms

Cankerworms continued to defoliate American elms along river bottoms in the eastern part of North Dakota, and many Siberian elm shelterbelts throughout the State were completely stripped of leaves by late June. A pilot control project/demonstration of aerially applied *Bacillus thuringiensis*, Bt, at a dosage of one-half pound per acre was conducted near Bismarck, ND in late May. Two formulations, one-half pound of Bt in one gallon of water per acre and one-half pound of Bt in three gallons of water per acre were applied. The three gallon per acre formulation provided the most consistent foliage protection to treated shelterbelts, but both spray formulations protected treated shelterbelts from defoliation as compared to untreated shelterbelts (figure 8) (figure 9).

Figure 7.–Entomologist attaching pheromone baited sticky-trap to detect tussock moth populations.

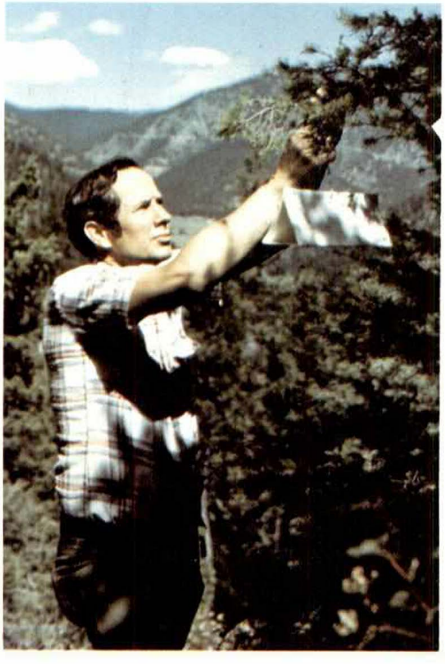

Figure 8.–Treated (½ lb. of BT/3 gal. water) shelterbelt showing effectiveness vs. untreated in figure 9.

Figure 9.–Untreated shelterbelt showing defoliation by spring and fall cankerworm.

Pine Butterfly

The pine butterfly infestation in Montana continued to decline in 1978. Aerially visible defoliation decreased from 1,100 acres in 1977 to 383 acres in 1978. The outbreak is confined to the Flathead Indian Reservation and the National Bison Range. The egg-mass survey only revealed eggs present in one ponderosa pine stand on the Bison Range. Very light defoliation is predicted in 1979.

A Pine Needle Miner

Heavy damage by this moth first appeared in The Northern Region during 1977 when bout 10,000 acres were infested in western Montana (figure 10). Aerially visible defoliation in 1978 was limited to 3,182 acres of ponderosa pine on the Flathead Indian Reservation.

Two areas northwest of Missoula and a pine grove on the University of Montana campus were also infested. Based on an overwintering larval survey, very light to light defoliation will occur in 1979 in areas presently infested.

Sawflies

In 1977, over 26,822 acres of western larch were heavily defoliated by sawflies in Montana. In 1978, no aerially visible defoliation was detectable. However, needle diseases on larch caused much discoloration and may have masked much of the sawfly damage. A ground survey on the Kootenai National Forest, Montana showed light sawfly populations present in two drainages north of Libby.

Gouty Pitch Midge

This insect infrequently reaches outbreak conditions in Region 1. In 1977, it infested several thousand acres in the Lochsa River drainage in Idaho, and by the end of 1978 it had spread throughout most of northern Idaho. Damage is most severe to ponderosa pine saplings which suffer mortality of many of the current years shoots (figure 11).

Unidentified Tortricid

An unidentified tortricid severely defoliated mountain hemlock, subalpine fir, grand fir, western white pine, and lodgepole pine on about 30 to 40 acres within the Shoshone Creek drainage, Wallace Ranger District, Coeur d'Alene NF. Specimens have been sent to the National Museum for identification (figure 12).

Figure 10.–Pine needle miner actively feeding on a ponderosa pine needle.

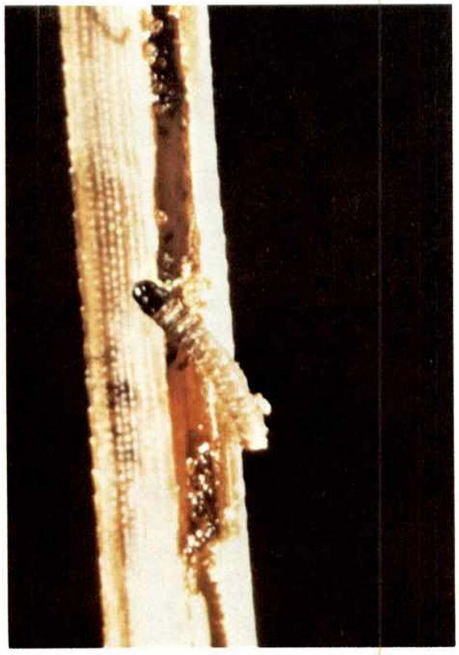

Figure 11.–Gouty pitch midge attacking current year shoots on its principal host, ponderosa pine.

Figure 12.–Unidentified tortricid feeding on mountain hemlock on Wallace Ranger District, Coeur d'Alene NF.

Pathology

Nursery Diseases—Gray mold caused significant losses of bare-root and container-grown western larch and pine. One greenhouse operation lost nearly all of its western larch crop, and one District lost 17 M container-grown western larch. Most seedlings were dead before outplanting. Examination of several areas showed death of numerous outplanted seedlings. The problem was caused by seedling storage in a damp barn containing moldy straw.

About 150 M ponderosa and lodgepole pine seedling were culled because of needle browning due to an unidentified needle pathogen.

Ponderosa and lodgepole pine in seedbeds, and Douglas-fir and western larch in greenhouses were hard hit by root pathogens. Losses approached 25 percent in seedbeds and 10 percent in greenhouses.

Needle Disease—A needle disease caused minor defoliation of western redcedar on the Idaho Panhandle NF's.

Redband needle blight defoliated ponderosa pine on the lower Lochsa and lower Priest River drainages. Other needle diseases of ponderosa pine were minor.

Lodgepole pine needle cast caused serious needle discoloration and defoliation in the upper Lochsa River and throughout Montana, but was not a problem in northern Idaho. Pine needle rust occurred infrequently, often associated with other needle pathogens.

Extent and severity of a needle blight on western white pine was less noticeable this year. Two other needle casts were locally severe throughout the white pine type.

Only minor defoliation resulting from infection by two needle rusts occurred on Douglas-fir.

Severe discoloration of western larch resulting largely from *Meria* needle cast occurred on the Kootenai, Flathead, Clearwater, and Idaho Panhandle NF's. Minor defoliation of western larch resulted from larch needle blight and larch needle rust infections scattered throughout the Region.

Needle diseases of true firs and spruce remained endemic.

Aspen were heavily infected by a leaf rust throughout Idaho and Montana. Aspen and cottonwood are alternate hosts; western larch and Douglas-fir are primary hosts for this rust. New aspen leaves in northern Idaho and northwestern Montana were blackened and shriveled by a leaf spot disease. Infection by canker causing pathogens and stem rusts apparently remained static; stem decays also remained static.

Root Diseases—Major root disease problems have been identified and discussed in previous condition reports. Several new root disease situations and problems were identified this year. Through aerial and ground surveys, we identified *Armillaria* root disease centers throughout the Rocky Mountain Division of the Lewis and Clark NF, west into the Flathead NF, south into the Lolo NF, and as far east as the eastern edge of the Jefferson Division of the Lewis and Clark NF. Centers ranged from a few acres to nearly a thousand acres and seemed to be associated with Douglas-fir in Douglas-fir/subalpine fir habitat types, often on highly permeable limestone soils.

Black stain root disease was associated with death of 50 to 60 year old eastern white pine on the Idaho Panhandle NF's. Presence of the fungus was verified by a chocolate brown stain in the sapwood of the roots, extending 3 to 4 feet up into the butt (figure 13). The same fungus was also associated with mortality of machine-planted 15 to 17 year old Douglas-fir on the Lincoln Ranger District of the Helena NF. Staining and death was associated with poor root systems resulting from improper planting.

Blowdown of mature Douglas-fir leave trees (shelterwood and seed tree cuts) occurred in northwest and west central Montana. Roots were extensively decayed, often resulting in truncated buttress roots 2 to 3 feet below ground level. Direct mortality resulting from decay was not observed. Three root disease fungi were associated with the decay which extended several feet into the butts of affected trees (figure 14).

Figure 13.–Roots of Douglas-fir sapling infected with Verticidadiella sp. Note characteristic chocolate brown stain.

White Pine Blister Rust—We completed the final evaluation of a 10-year study of the effectiveness of *Ribes* eradication as a control of white pine blister rust in Yellowstone National Park. Eradication started in 1947, but effectiveness was a matter of conjecture. *Ribes* eradication was suspended from 1968 to 1978 in 18 white pine stands to allow *Ribes* and rust the opportunity to increase. Eleven stands outside the control units were selected as checks. Neither rust nor *Ribes* increased during the 10-year period; both were essentially absent from the treated stands. Even though *Ribes* populations were comparatively high in the check stands, rust was nearly absent. We concluded that eradication of *Ribes* was not effective in limiting rust spread and intensification in Yellowstone National Park.

Air Pollution—Sulfur dioxide caused needles on several hundred ponderosa pine to turn brown in 1978, 4 to 6 miles south of the American Smelting and Refining Company lead smelter at Helena, Montana. All damaged trees were on private property and the evaluation was done cooperatively with the State of Montana. No mortality was noted, but trees on much of the affected area were in poor vigor, presumably because of the SO_2 pollution. FIDM presented formal testimony concerning the damaged trees to the Montana Board of Health and Environmental Sciences at a variance hearing. The company is under stipulation by the State to reduce SO_2 emissions to about 80 tons/day, and should achieve this level by 1980. Current emissions are 300 tons per day. We anticipate that if compliance is achieved, very little SO_2 injury to plants will occur.

An intensive field evaluation of the impact of SO_2 on conifer habitat types near the Anaconda Copper Smelter at Anaconda, Montana, was done in 1978. Plots were established on subalpine fir/beargrass and whitebark pine habitat types. Basal area of commercially important conifers and frequency and coverage of shrubs, forbs, and grasses decreased near the smelter. Severely affected areas were nearly denuded of flora and as much as 30 cm of soil had sheet-eroded from the sites. Sulfur dioxide symptoms were found on conifers as far as 8 miles downwind of the smelter. Volume loss was estimated to be 3 MMCF on about 100 M acres. Primary effects, including tip necrosis and mottle on conifer needles, was seen on an additional 50 M acres.

Litigation by the U.S. Department of Justice against the Anaconda Aluminum Company at Columbia Falls, Montana, was initiated during November 1978 on behalf of the U.S. Department of Agriculture, Forest Service, and the U.S. Department of Interior, National Park Service. The suit claims that fluoride from the aluminum plant has damaged timber, wildlife, and esthetic values and seeks compensation for the losses. An injunction is also asked in which the company could emit no more than 200 pounds of fluoride per day, compared to the present 4000 pounds per day. This action culminates nearly 10 years of study by FIDM concerning fluoride damage at Columbia Falls.

Two new 500 foot smokestacks were recently completed on a lead and zinc smelter at Kellogg, Idaho, causing SO_2 to be distributed greater distances. Chlorotic conifer foliage was noted in some previously undamaged areas.

Figure 14.–Douglas-fir root approx. 6" in diameter, callused off because of infection by a complex of organisms including Fomes annosus, Polyporus schweinitzii, and Polyporus tomentosus.

Dwarf Mistletoe—The dwarf mistletoes are one of the major groups of damaging organisms in the Region.

Most control is done along with normal timber management activities and is financed from timber funds. A limited amount of control is done with special projects financed by FIDM. In 1978, we financed 5,700 acres of control on the Bitterroot, Deerlodge, Flathead, and Lewis and Clark NF's (figure 15). In addition, FIDM financed presuppression surveys on 800 acres of the Flathead, 6,400 acres of the Gallatin, and 4,000 acres of the Kootenai NF's.

We collected lodgepole pine dwarf mistletoe for the first time in the Castle Mountains in Meagher County and the Pryor Mountains in Carbon County, Montana. The specimens were deposited in the National Mistletoe Herbarium in Fort Collins, Colorado.

As part of a west-wide effort to assess dwarf mistletoe-caused growth loss in lodgepole pine, we surveyed parts of the Beaverhead, Custer, Deerlodge, Gallatin, Helena, and Lewis and Clark NF's. A road/plot sample scheme developed by the Methods Application Group was used. Crews drove all passable roads through the lodgepole pine type and recorded changes in timber type, size class, and mistletoe infection intensity for a strip on the right side of the road. They also measured diameter breast height, height, and dwarf mistletoe intensity (six-class system) of lodgepole pine on variable plots at 3-mile intervals. The crews surveyed nearly 3,200 miles of road and sampled more than 25,000 acres.

Weather Damage—We expected the drought of 1976-1977 to cause some conifer injury and/or death in 1978, but we received no more than the usual number of drought-related reports or specimens.

Wind-thrown trees were more numerous on the Beaverhead, Gallatin, and Lewis and Clark NF's than in previous years.

Figure 15.–Cutting dwarf mistletoe infested residual lodgepole pine to protect new stand.

Dutch Elm Disease—Dutch elm disease occurs in scattered locations throughout North Dakota; in Missoula and Ravalli Counties in western Montana; and in Billings (Yellowstone County) in central Montana.

More than 200 American elms in Billings were confirmed as infected during the summer. Although this is the first reported occurrence of Dutch elm disease in Billings, we believe it has been present for at least 6 years and probably for as long as 8 to 10 years. The Billings City Forester has initiated a control program of frequent surveys, prompt sanitation, early spring spraying with methoxychlor, and severance of root grafts with Vapams.

The University of Montana, Missoula, removed an additional 11 trees in 1978. Their program is sanitation and replacement planting of other tree species.

Appendix

INSECT NAMES

Common Name	Scientific Name
Mountain Pine Beetle	*Dendroctonus ponderosae* Hopkins
Pine Engraver Beetle	*Ips pini* (Say)
Douglas-fir Beetle	*Dendroctonus pseudotsugae* Hopkins
Western Spruce Budworm	*Choristoneura occidentalis* Freeman
Larch Casebearer	*Coleophora laricella* (Hubner)
Cone Midges	*Contarinia oregonensis* Foote and *C. washingtonensis* Johnson
Cone Worms	*Dioryctria abietivorella* (Grote) and *D. auranticella* (Grote)
Forest tent caterpillar	*Malacosoma disstria* (Hubner)
Douglas-fir Tussock Moth	*Orgyia pseudotsugata* (McDunnough)
Canker Worms	*Alsophila pometaria* (Harris) and *Paleacrita vernata* (Peck)
Pine Butterfly	*Neophasia menapia* (Felder & Felder)
Needle Miner	*Coleotechnites sp.*
Sawflies	*Anoplonyx sp.*
Gouty Pitch Midge	*Cecidomyia piniinopis* Osten Saken
Unidentified Tortricid	(Unidentified)

DISEASE NAMES

Common Name	Scientific Name of Causal Agent
Armillaria root disease	*Armillaria mellea* (Vahl ex fr.) Kumm.
Aspen leaf rust	*Melampsora medusae* Thuem.
Aspen leaf spot	*Marssonina populi* (Lib.) Magn.
Black stain root disease	*Verticicladiella* sp.
Douglas-fir needle rust	*Melampsora occidentalis* Jacks
Dutch elm disease	*Ceratocystis ulmi* (Buism.) C. Mor.
Dwarf mistletoes	*Arceuthobium* spp.
Gray mold	*Botrytis cinerea* Pers. ex Tr.
Larch needle blight	*Hypodermella laricis* Tub.
Lodgepole pine dwarf mistletoe	*Arceuthobium americanum* Nutt. ex Engelm.
Lodgepole pine needle cast	*Lophodermella concolor* (Dearn.) Darker
Meria needle cast	*Meria laricis* Vuill.
Pine needle rust	*Coleosporium asterum* (Diet.) Syd.
Redband needle blight	*Scirrhia pini* Funk and A.K. Parker
Redcedar needle disease	*Didymascella thujina* (Durand) Maire
White pine blister rust	*Cronartium ribicola* J.C. Fisch.
White pine needle blight	*Lecanosticta* sp.

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